PATENT SPECIFICATION

(11) 1 476 707

(21) Application No. 16768/75 (22) Filed 23 April 1975
(31) Convention Application No. 483916
(32) Filed 28 June 1974 in
(33) United States of America (US)
(44) Complete Specification published 16 June 1977
(51) INT CL^2 B41F 13/08
(52) Index at acceptance
B6C 56N1 56N4

(19)

1 476 707

(54) PRINTING PLATE ARRANGEMENT

(71) We, ROCKWELL INTERNATIONAL CORPORATION, a corporation of the State of Delaware, U.S.A., having a place of business at 600 Grant Street, Pittsburgh, Pennsylvania, U.S.A., do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:—

In conventional rotary web newspaper printing presses a plurality of semi-cylindrical, stereotype plates are mounted about the periphery of the respective plate cylinders in such a manner that longitudinal gaps or gutters are formed between the leading and trailing edges of the plates. In a double width press, for example, the plate cylinders carry four plates across and two plates around so that at least two such gutters are formed 180° apart in each set of four plates. If these gutters are aligned so as to form continuous gaps along the full length of the plate cylinder, severe shocks will be imparted to the plate and coacting impression cylinder each time a gutter passes through the printing nip and the resultant vibrations will adversely affect the printing quality. When printing tabloid size pages, two additional gutters are formed in each set of plates and it will be obvious that the problems caused by vibrations are further aggravated.

In order to reduce the magnitude of the shocks and resultant vibrations, it has long been the practice to stagger the plates about the periphery of the plate cylinder. In other words, the plates are located so that the gutters formed between the set of four plates at one end of the plate cylinder are displaced angularly relative to the gutters formed by the set of four plates at the other end of the plate cylinder. As a result, each gutter will extend only one half the length of the plate cylinder and they will pass through the printing nip at spaced intervals during each printing cycle so that the abrupt pressure variations between the plate and impression cylinder are substantially reduced.

Although the practice of staggering the plates has helped to reduce the severity of the shocks imparted to the cylinders, nevertheless it has failed to eliminate streaking problems caused by gutter induced vibrations and which are particularly prevalent at normal operating speeds. It has been discovered that this is due to the fact that the stagger angles used heretofore inherently produce impulses, at normal operating speeds, which occur at an interval equal to an integral multiple of the natural period of the cylinders. Consequently, the cylinders are caused to vibrate at amplitudes which are substantially greater than they would be if the impulses were to occur at another interval.

According to the invention there is provided a rotary printing press including a plate cylinder and a coacting cylinder forming a nip therebetween, a plurality of sets of printing plates mounted on said plate cylinder and forming longitudinally disposed gutters therebetween at equally spaced intervals about the circumference of the plate cylinder, a plurality of plate clamp assemblies on said plate cylinder for securing the respective sets of plates in position thereon, the plate clamp assembly for one of said sets of plates being offset circumferentially of said plate cylinder relative to the plate clamp assembly for another of said sets of plates whereby the longitudinal gutters in the said one set of plates are displaced circumferentially relative to the gutters in said another set of plates by an angle of within the range of 48° to 57°.

A preferred embodiment of the invention is now more particularly described with reference to the accompanying drawings, wherein:

Figure 1 is a schematic elevational view of a conventional rotary newspaper printing press unit;

Figure 2 is a view illustrating one printing couple of the unit of Figure 1;

Figure 3, is a sectional view taken substantially along line 3—3 of Figure 2;

Figures 4 to 7, are graphs depicting the relationship between the gutter induced vibrations and the natural frequencies of the cylinders at various stagger angles;

Figures 8 and 9 are graphs depicting the differences in amplitudes of deflections between 30°—60° stagger angles and 51° stagger angle over the normal range of press speeds, and

Figure 10, is a graph illustrating the vibration characteristics throughout the practical range of stagger angles.

With reference now to the drawings the invention is illustrated and will be described as embodied in a rotary web newspaper press of the letterpress type and having plate cylinders adapted to accommodate six stereotype plates across and two around. Such presses are commonly referred to as 6×2 presses as distinguished from the more conventional 4×2 presses. The invention is particularly advantageous in this size press because the longer cylinders are obviously subject to more excessive vibrations. However, it shall be understood that the invention can be used with advantage in the smaller 4×2 presses as well as in rotary lithographic offset newspaper presses of comparable sizes.

For example, anyone skilled in the art will recognize that whereas in relief printing the web is passed through a nip formed by the plate and impression cylinders, in lithographic offset printing the web passes through the nip formed by the blanket and impression cylinders or by two blanket cylinders. Nevertheless the plate and blanket cylinders form a nip under considerable impression pressure and thus the grooves or slots provided in these cylinders to accommodate the plate clamping means induce vibrations in all of the printing cylinders and therefore, the angular location of these slots is just as important as the location of the gutters formed between stereotype plates of a relief type printing press.

With more particular reference now to Figure 1 of the drawings the invention is illustrated as embodied in a typical rotary web newspaper press unit having spaced apart side frames 10. The plate cylinder 11 and coacting impression cylinder 12 of a first printing couple are journalled for rotation in the side frames 10 and these cylinders form a first printing nip at 13 for printing upon one side of a web 14. A second printing couple is formed by the plate cylinder 16 and coacting impression cylinder 17 which cylinders also are journalled for rotation in the side frames and form a second printing nip at 18 for printing upon the other side of the web 14.

Ink is transferred from a reservoir, not shown, to the printing plates on the plate cylinder 11 by an inking mechanism indicated at 21 and which includes a plurality of distributing rollers 22, ink drums 23 and two or more form inking rollers 24 which run in contact with the plates on the cylinder 11. In a similar manner the plates on the plate cylinder 16 receive ink from a second reservoir, not shown, by means of an inking mechanism indicated at 26 and which also includes ink distributing rollers 27, ink drums 28 and form inking rollers 29.

The plate cylinders 11, 16 and coacting impression cylinders 12, 17 are adjusted or made-ready so that a substantial impression pressure is exerted between the coacting surfaces in the printing nips 13, 18. A "squeeze" of about .008 inch is generally employed to assure proper transfer of the ink from the plates to the web, i.e. the co-acting cylinders are adjusted so that the distance between their centres is .008 inch less than the sum of the radii of the acting peripheral surfaces thereon. Therefore, as the web 14 travels in the direction indicated in Figure 1, it will receive a plurality of ink impressions from the plate cylinder 11 as it passes through the printing nip 13. Thereafter, the web is directed through the printing nip 18 where it receives a corresponding number of impressions on the opposite side thereof from the plate cylinder 16. Upon leaving the printing unit the printed web is then slit, folded, associated with other webs, and finally delivered as a completed newspaper all of which takes place at high speeds.

The number of pages printed by each plate cylinder obviously depends upon its size and the number of plates it carries. In the present instance each plate cylinder is adapted to print twelve full size or broadsheet pages per revolution and as will be seen in Figure 2, twelve stereotype plates 31 are mounted about its periphery. The plates are preferably arranged in sets of four, with the plates 31 at the left end of the cylinder 11, as viewed in Figure 2, being considered the "near" set, the plates 31″ at the other end of the cylinder being referred to as the "far" set, and those in the middle 31′ constituting the "center" set.

The stereotype plates, as is well known, are semi-cylindrical in form so that they can be quickly removed and replaced when necessary and, therefore, when they are mounted on the plate cylinder, gaps or gutters 32 are formed between the leading and

trailing edges of each pair of plates. These gutters are spaced 180° apart and coincide with the margins at the top and bottom of the broadsheet pages. If tabloid size pages are to be printed, it will be understood that each stereotype plate will be provided with an artificial gutter as is indicated at 32a in Figure 2 and which is located midway or 90° from the natural gutters 32. In such case a total f four longitudinal gutters will be present in each set of plates and each plate cylinder will produce twenty-four tabloid pages per revolution.

In order to provide suitable backing for the web 14 as it travels through the printing nip 13, it is customary to provide the impression cylinder 12 with a resilient blanket 33. Preferably the blanket is comprised of three sections 33, 33′ and 33″, each of which covers a two-plate wide section of the impression cylinder. These blankets are wrapped completely around the cylinder circumference and the respective ends thereof are secured in position by clamp means, not shown, but which are located within grooves or slots 34, 34′ and 34″ provided therefore in the periphery of the impression cylinder. Only one such slot is required for each blanket section and they are located in angular positions on the impression cylinder so they will coincide with a gutter 32 in the associated set of printing plates.

The stereotype plates are secured in position on the plate cylinder by tension lockup means, see Figure 3, in a manner that the leading edge of one plate is adjacent the trailing edge of the other plate, thereby forming the gutters 32. As will be apparent from Figure 3, the leading edge of two plates of the "near" set are secured in position by a plurality of aligned fingers 36 which project beyond the periphery of the cylinder to engage slots 37 milled in the inner face of the plates. The trailing end of each "near" set plate is in turn secured in position by constant tension means in the form of a series of fingers 38 that are pivotally mounted in bosses 39 formed on an actuating shaft 41. When the shaft 41 is rotated in clockwise direction, the fingers 38 are retracted below the cylinder surface to facilitate mounting and removal of the plates. When the shaft 41 is rotated in counterclockwise direction, the fingers 38 engage milled slots 42 in the plate to lock it in position. During the final movement of the actuating shaft 41 in the locking direction, pads 43 on each of the fingers 38 are adapted to compress springs 44 located in recesses 46 formed in the shaft 41 and thus maintain a constant tension on the plate in the locked-up position.

The "center" set of plates is locked up by a separate plate clamping assembly indicated in its entirety at 51. The elements are identical to the clamp means for the "near" set of plates and are identified by similar reference numbers with the addition of the subscript "*a*". The only difference is that the actuating shaft 41*a* is provided with an extension so that it can be manually actuated between locking and release positions from the "near" end of the cylinder.

The respective actuating shafts are adapted to be actuated by collars and toggle link means as schematically illustrated at the bottom of Figure 3. Since these elements are not critical to the invention, however, they will not be described in detail and for a more complete description of the entire lock-up assembly reference may be had to United States patent 2,900,903.

It also should be understood that the plates of the "far" set are arranged to be secured in position by identical plate clamping assemblies. The locking fingers and actuating shafts of the "far" set are aligned with the corresponding elements of the "near" set assemblies and they are adapted to be actuated by toggle means located at the "far" end of the plate cylinder.

From the description thus far, it will be readily evident that when a press as illustrated in Figure 1 is operated at web speeds of approximately 2000 fpm, severe shocks would be imparted to the plate and impression cylinders as the gutters 32 pass through the printing nip, particularly if the gutters are aligned along the full width of the cylinders. This would be due to the abrupt interruption of the rather substantial impression pressure between the cylinders and would be further aggravated by the resilient nature of the blankets on the impression cylinder. To reduce the magnitude of the shocks it has long been the practice to stagger the plate clamping assemblies by an angle X, as indicated in Figure 3, so that the gutters of one set of plates would be angularly displaced relative to the gutters in an adjacent set or sets of plates. In this way the pressure between the coacting cylinders is not entirely relieved at any point in the cycle and improved results were achieved. However, shocks or impulses are still induced in the printing cylinders to an extent sufficient to produce vibrations therein and which are readily apparent as "streaks" in the printed products.

It has been discovered that this streaking problem is primarily due to the stagger angles used heretofore and that the condition can be vastly improved by the adoption of the correct angle.

In the past, it has been the practice to provide cylinders having either 45°, 60° or 90° stagger angles. The 90° angle is used quite extensively for printing broadsheet products but it is impractical for tabloid size products. If tabloid size products were to be printed, the artificial gutters in one set of plates would obviously become aligned with the natural gutters of an adjacent set of plates and thus the purpose of the 90° stagger would be defeated.

The 45° and 60° staggers have therefore, been most widely used, but because the gutter impulses produced by these angles proved to be integral multiples of the natural period of the cylinders at normal operating speeds, streaking remained a serious problem.

The effects produced with conventional gutter angles can perhaps be better understood with reference to Figures 4 to 7. Figure 4 depicts the condition existing when each of the three sets of plates are staggered by 30° relative to the adjacent set. This arrangement is not actually used, but serves to illustrate an extreme set of conditions.

As indicated, the natural period of the system is .0093 seconds and therefore, a press speed causing 30° of rotation in .0093 seconds will produce gutter induced impulses at precisely the same period. Consequently, the magnitude of the vibrations will be maintained at a maximum and serious streaking problems would occur.

It might be supposed that by arranging the stagger so that the gutters at the ends of the cylinder are aligned and advanced 30° with respect to the center gutter the resonance condition would be alleviated because every third impact would would be absent. However, because of the impulsive nature of the disturbance, this is not the case. Figure 5 shows an example of this condition wherein it will be seen that only a very slight reduction in amplitude is achieved in the oscillatory cycle.

It might also be supposed that spacing the gutters far enough apart, so that the gutter period will equal the natural period of the system only at a press speed above the operating range, would result in avoidance of the resonance-like condition. However, due to the impulsive nature of the disturbance, the resonance-like condition is generated whenever the gutter period is any integer multiple of the natural period of the system. Consequently, if the equal period condition is moved out of the normal speed range, a fractional period condition is brought in.

This is borne out by the illustration in Figure 6 wherein the gutters are spaced at 45°. In this case, the period between disturbances is equal to twice the natural period whereby the motion of the cylinders is being reinforced every second cycle and large cylinder movements still occur. It is evident, therefore, that no even spacing of the gutters will provide a useful range of speeds throughout which there will be no coincidence between the gutter impulses and the natural period or its multiples.

After careful study and analysis it has been found that by arranging the gutters of one set of plates so that they are spaced from the gutters of an adjacent set by an angle within the range of 48° to 57° a substantial reduction in the amplitude of the vibrations can be achieved. In such case, there is no possibility of the resonance-like impulses from one gutter being exactly in phase with the disturbances caused by the other gutter as was true in the previous examples and the vibrations caused by one gutter will tend to oppose the vibrations caused by the other.

Figure 7, shows the motions with a gutter spacing of 51° at a press speed exactly equal to that of Figure 5. It can be seen that rather than reinforcing one another as occurred in the previous example, the disturbance from one gutter tends to dampen the motions caused by the previous gutter. Consequently, the amplitudes of vibration of the cylinders are reduced.

The total effect over the operating range of press speeds can be seen in Figures 8 and 9 wherein the maximum peak-to-peak deflections of the plate and impression cylinders are plotted as a function of the press speed for the gutter angles discussed in connection with Figures 5 and 7. From these plots it will be seen that over the major portion of the range very little difference exists between the two arrangements. At the speed where the resonance-like condition wants to occur, however, the 51° stagger angle results in much lower deflections. To determine the combined effect of maximum deflection and press speed, a performance index (PI) of the following form can be used:

$$PI = \frac{1}{2}\left[\log_e \sum_{i=1}^{n} \frac{e^{x_{1i}}}{n} + \log_e \sum_{i=1}^{n} \frac{e^{x_{2i}}}{n}\right]$$

where

x_{1i}=maximum peak-to-peak deflection of cylinder 1 at speed i;

x_{2i}=maximum peak-to-peak deflection of cylinder 2 at speed i;

and the summation is over n speeds in the operating range.

Applying this performance index to gutter spacings from 30° to 60° results in the plot presented in Figure 10. These data clearly show that a minimum amplitude of deflection will be attained with gutter angles between 30° and 45° and between 45° and 60° with the optimum spacing for the natural gutters being at 51° and the spacing between the natural gutter and the next succeeding artificial gutter, when printing tabloid size sheets, being at 39°. Since the direction through which the angle is measured is arbitrary and the total angle of interest is 90°, these two minimums are effectively equivalent. That is, the larger angle equals 90° minus the smaller angle.

It will thus be evident that by spacing the natural gutters of one set of plates by 48° to 57°, and preferably 51°, from the natural gutters of an adjacent set or sets of plates, vastly improved results will be attained over and above the gutter angles used heretofore.

WHAT WE CLAIM IS:—

1. A rotary printing press including a plate cylinder and a coacting cylinder forming a nip therebetween, a plurality of sets of printing plates mounted on said plate cylinder and forming longitudinally disposed gutters therebetween at equally spaced intervals about the circumference of the plate cylinder, a plurality of plate clamp assemblies on said plate cylinder for securing the respective sets of plates in position thereon, the plate clamp assembly for one of said sets of plates being offset circumferentially of said plate cylinder relative to the plate clamp assembly for another of said sets of plates whereby the longitudinal gutters in the said one set of plates are displaced circumferentially relative to the gutters in said another set of plates by an angle of within the range of 48° to 57°.

2. A rotary printing press as set forth in claim 1 wherein the plate clamp assembly for one set of plates is offset circumferentially relative to the plate clamp assembly for another set of plates by an angle of 51°.

3. A rotary printing press as set forth in claim 1 or 2 wherein the coacting cylinder is provided about its periphery with a plurality of impression blankets, a plurality of clamp means for securing said blankets on the coacting cylinder, a plurality of longitudinal slots formed in the peripheral surface of said coacting cylinder to accommodate said clamp means, and the slot for one of said clamp means being displaced circumferentially relative to the slot for another of said clamp means by an angle equal to that between the gutters on the plate cylinder.

4. A rotary printing press according to claim 1 and substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

SHAW BOWKER & FOLKES,
Chartered Patent Agents,
St. Martin's House,
Bull Ring,
Birmingham, B5 5EY.
Agent for the Applicants.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1977
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1476707 COMPLETE SPECIFICATION

5 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 1

FIG-1

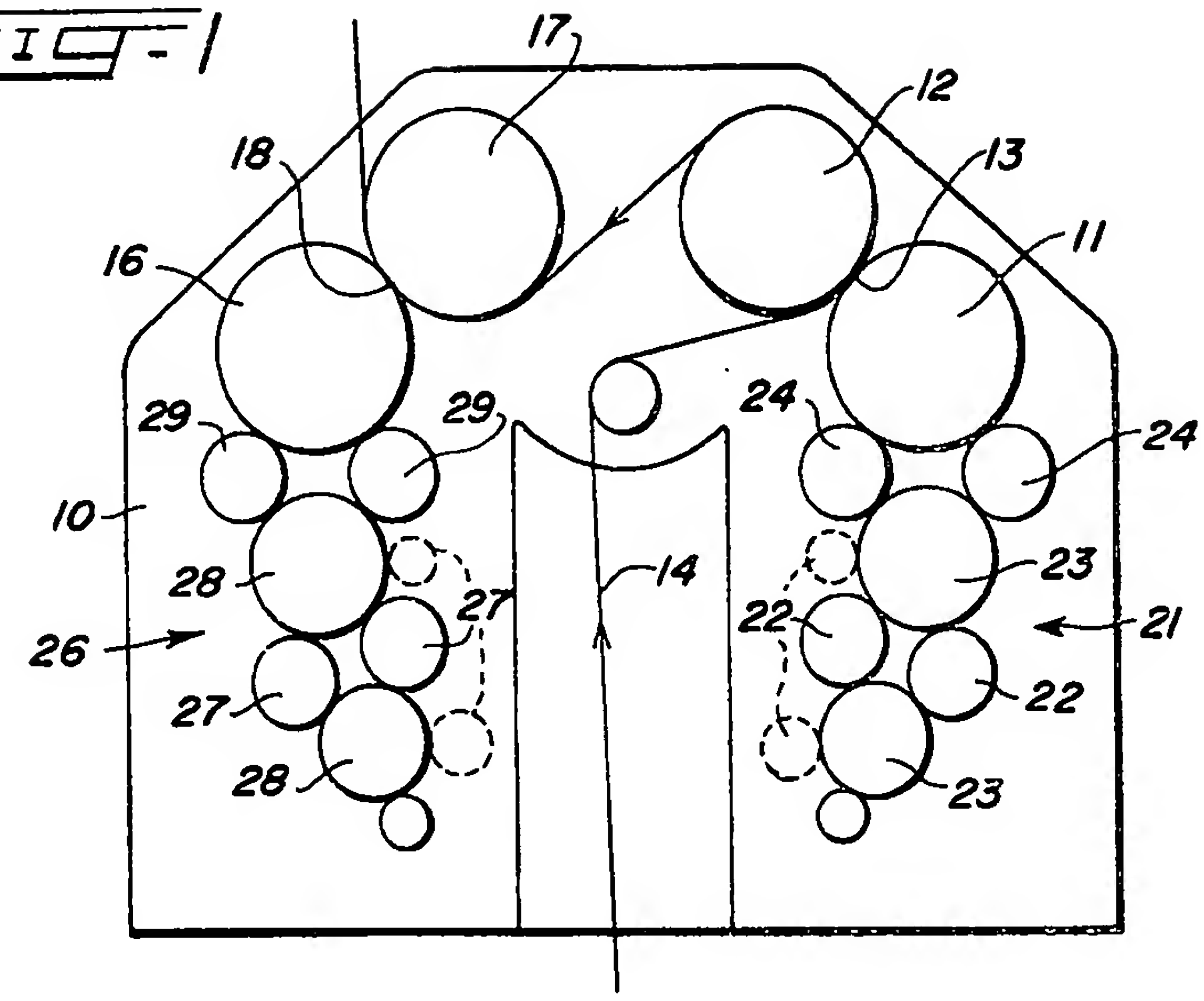
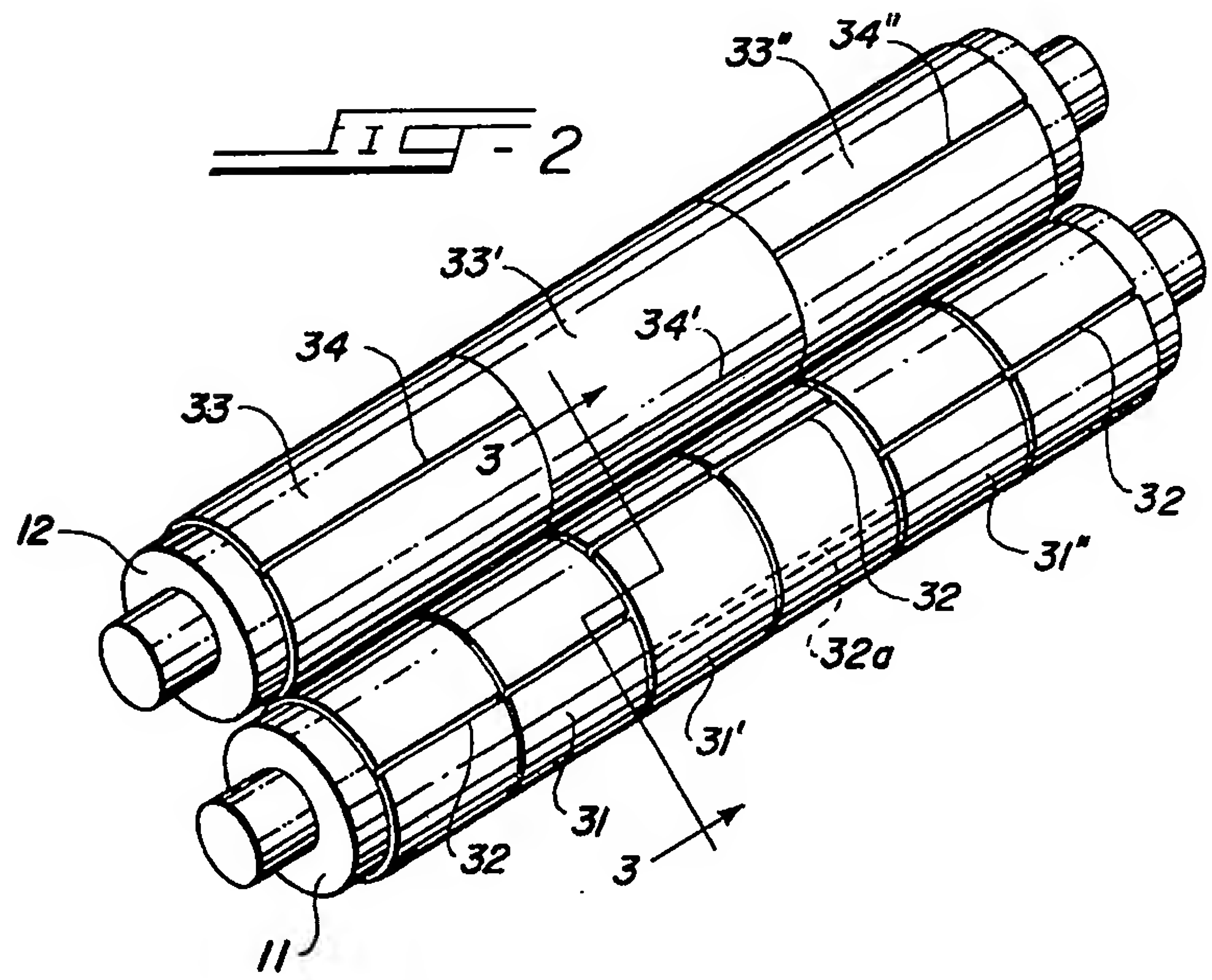


FIG-2

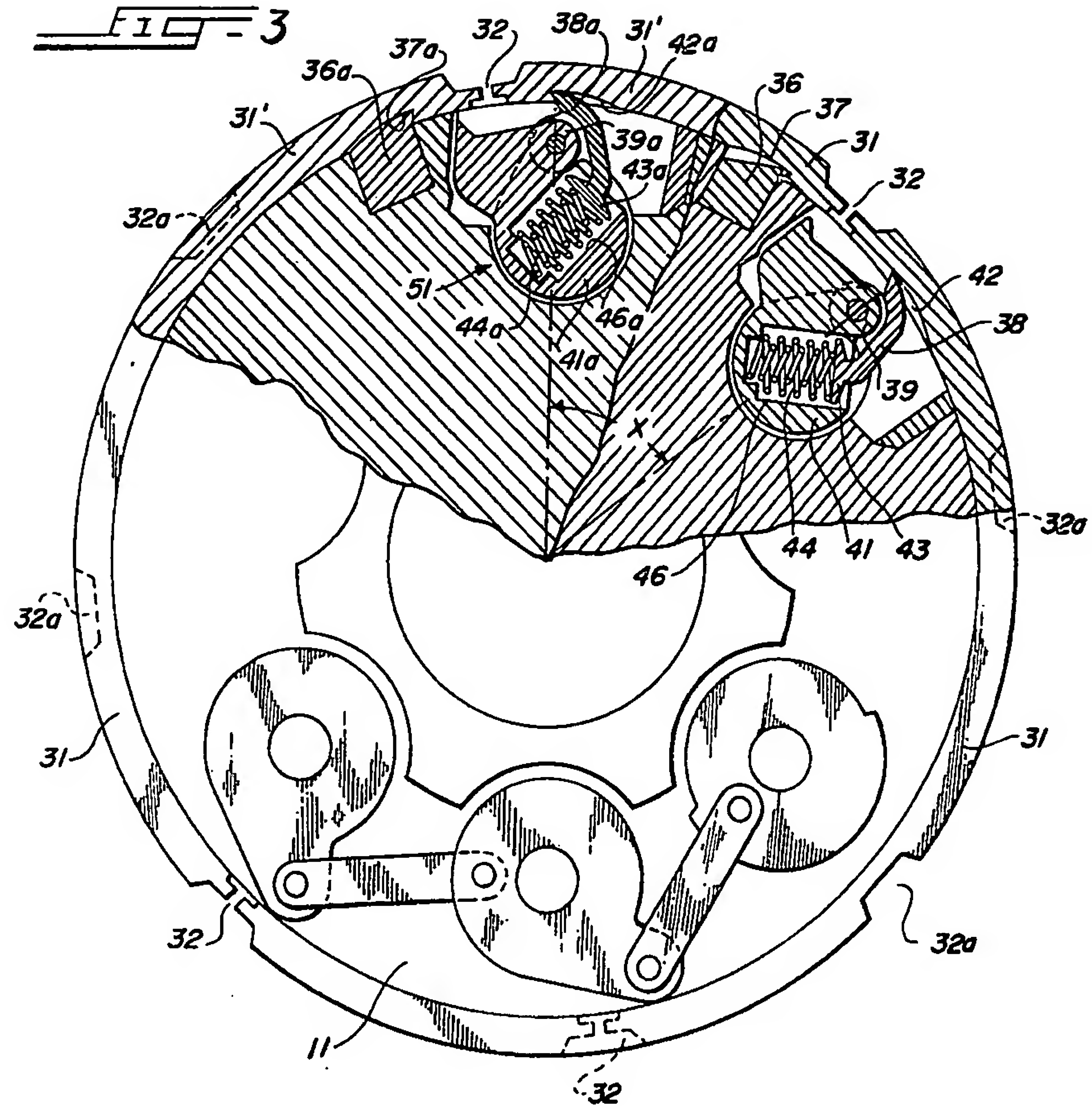


1476707 COMPLETE SPECIFICATION

5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

FIG-3



1476707 COMPLETE SPECIFICATION

5 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 3

FIG - 4

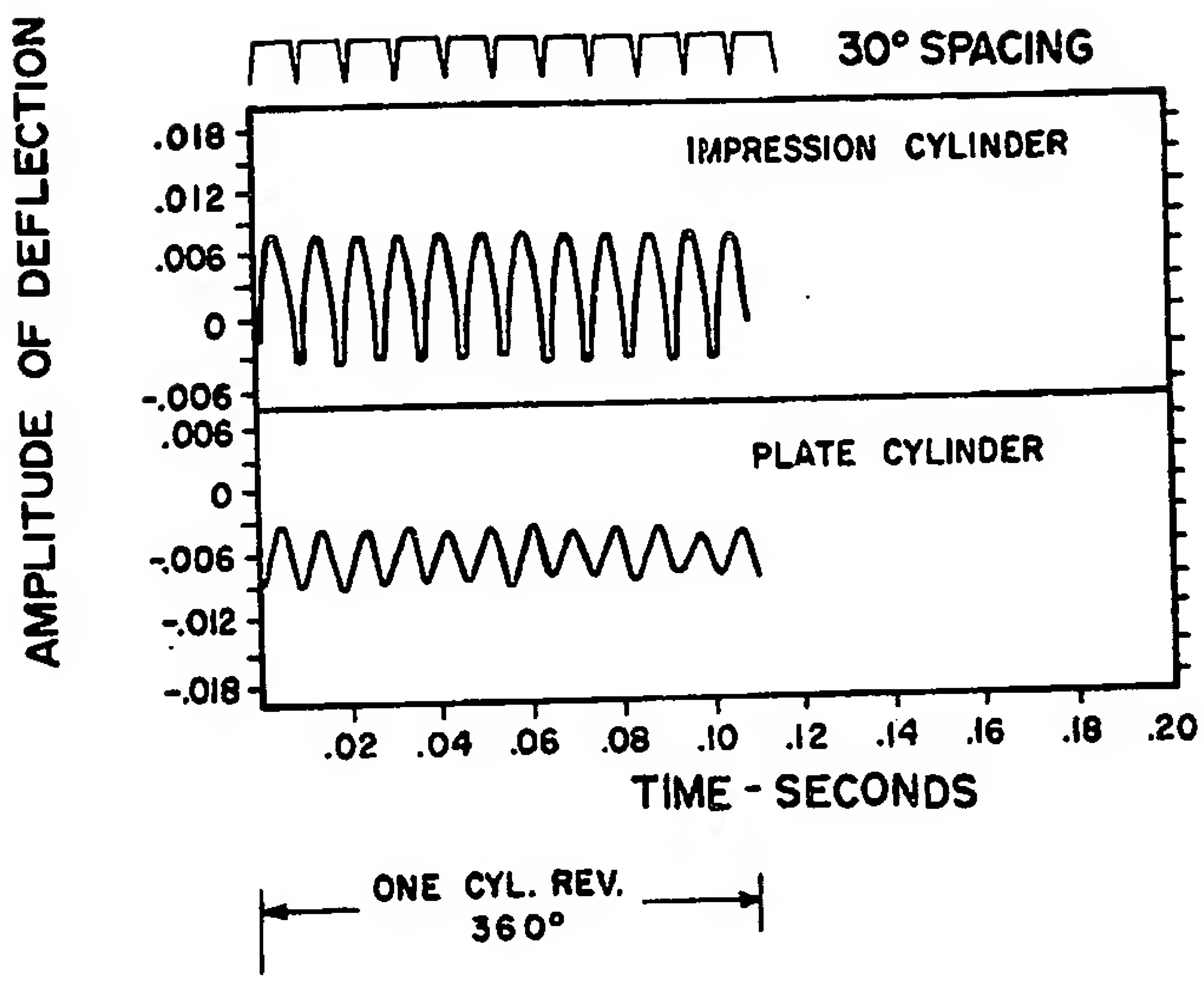


FIG - 5

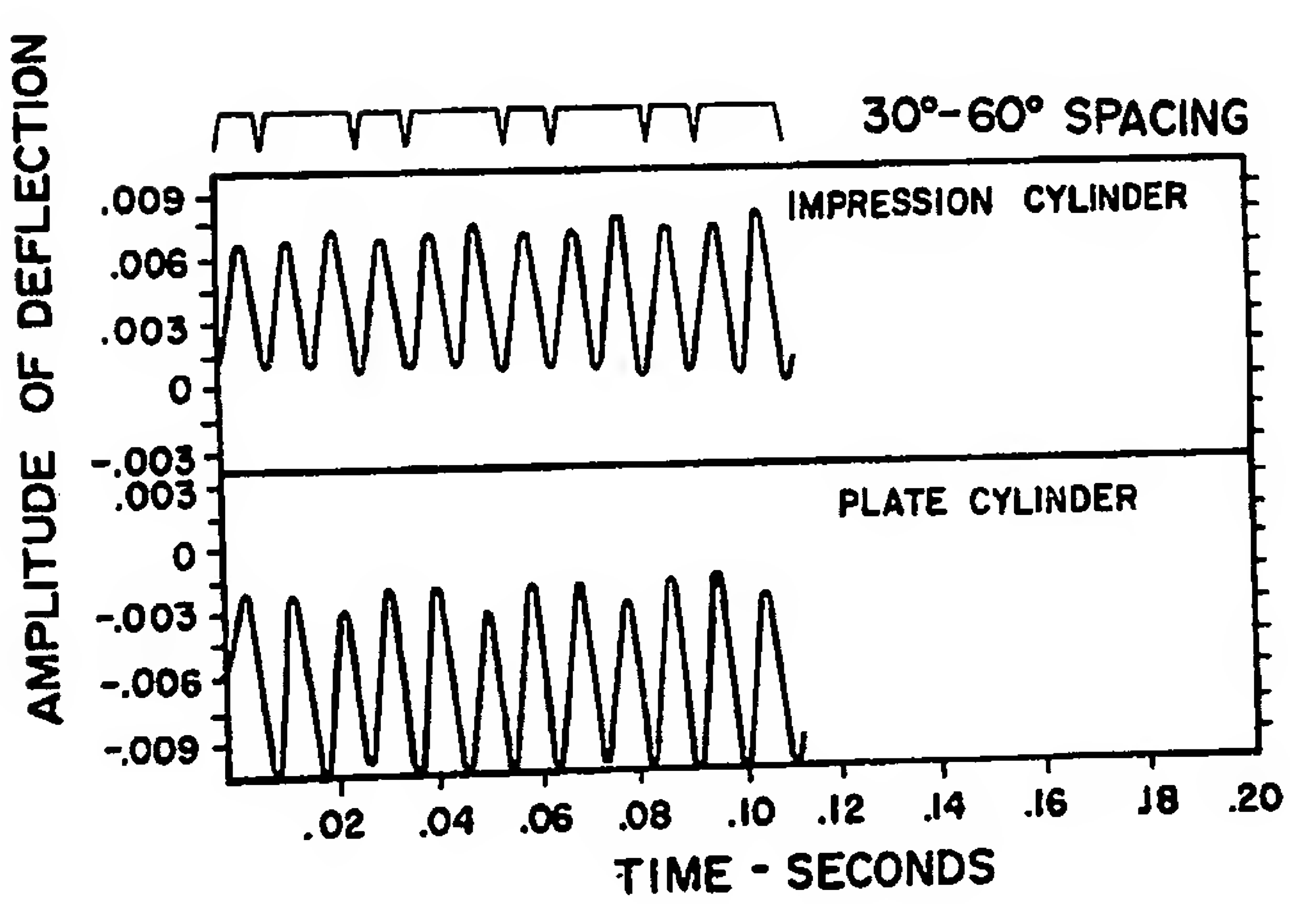


FIG-6

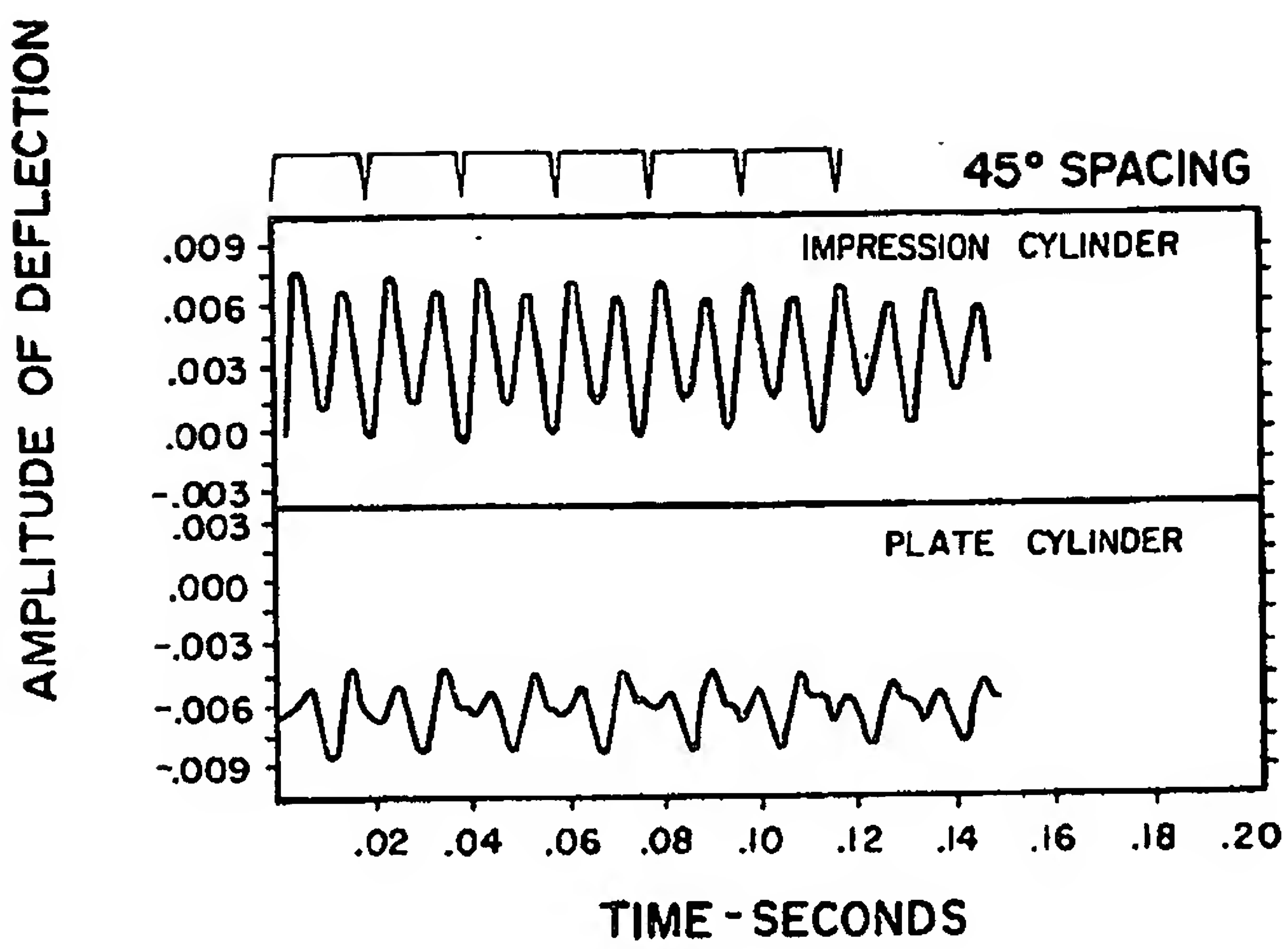
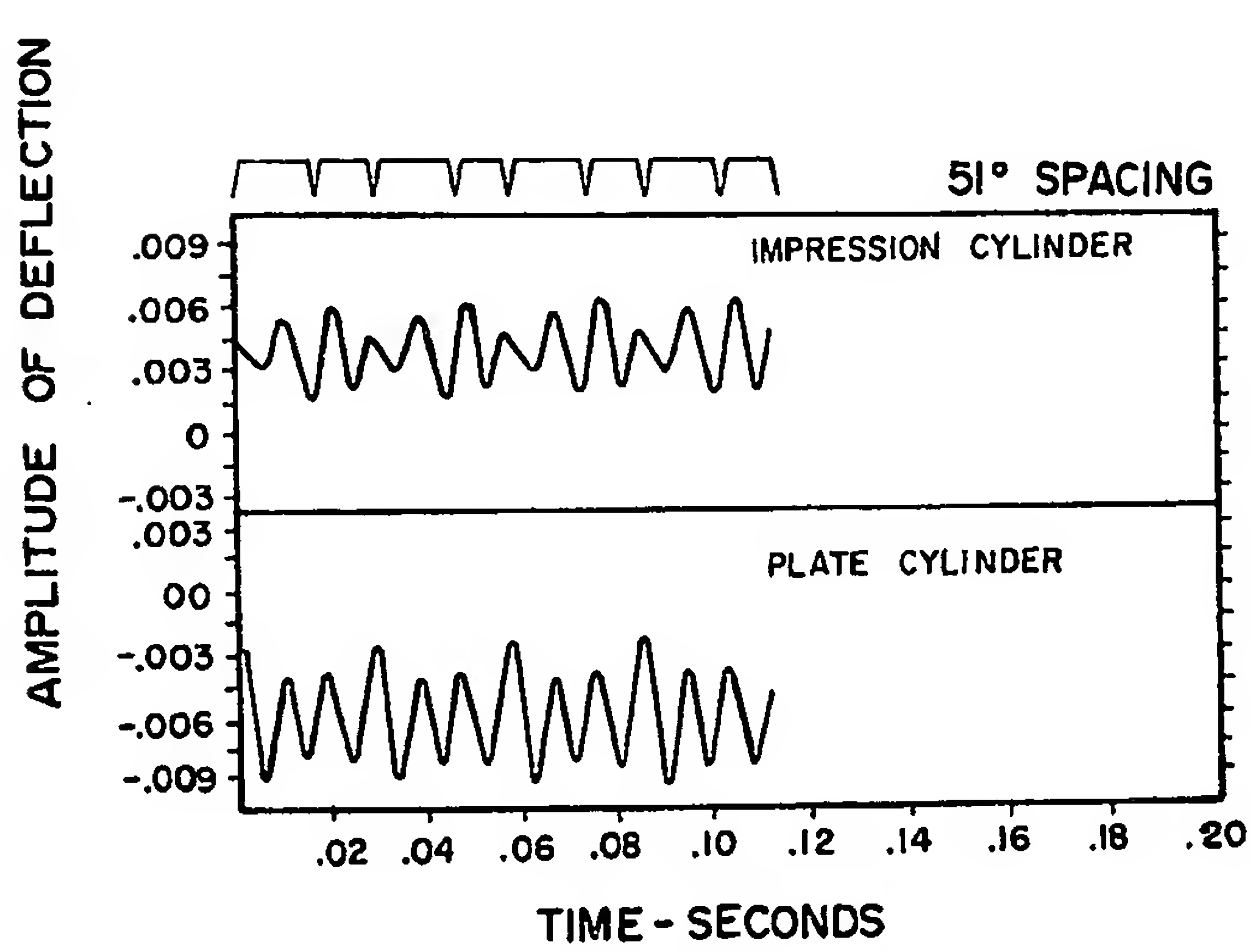

45° SPACING
AMPLITUDE OF DEFLECTION
IMPRESSION CYLINDER
.009
.006
.003
.000
-.003
PLATE CYLINDER
.003
.000
-.003
-.006
-.009
.02 .04 .06 .08 .10 .12 .14 .16 .18 .20
TIME - SECONDS

FIG-7


51° SPACING
AMPLITUDE OF DEFLECTION
IMPRESSION CYLINDER
.009
.006
.003
0
-.003
PLATE CYLINDER
.003
00
-.003
-.006
-.009
.02 .04 .06 .08 .10 .12 .14 .16 .18 .20
TIME - SECONDS

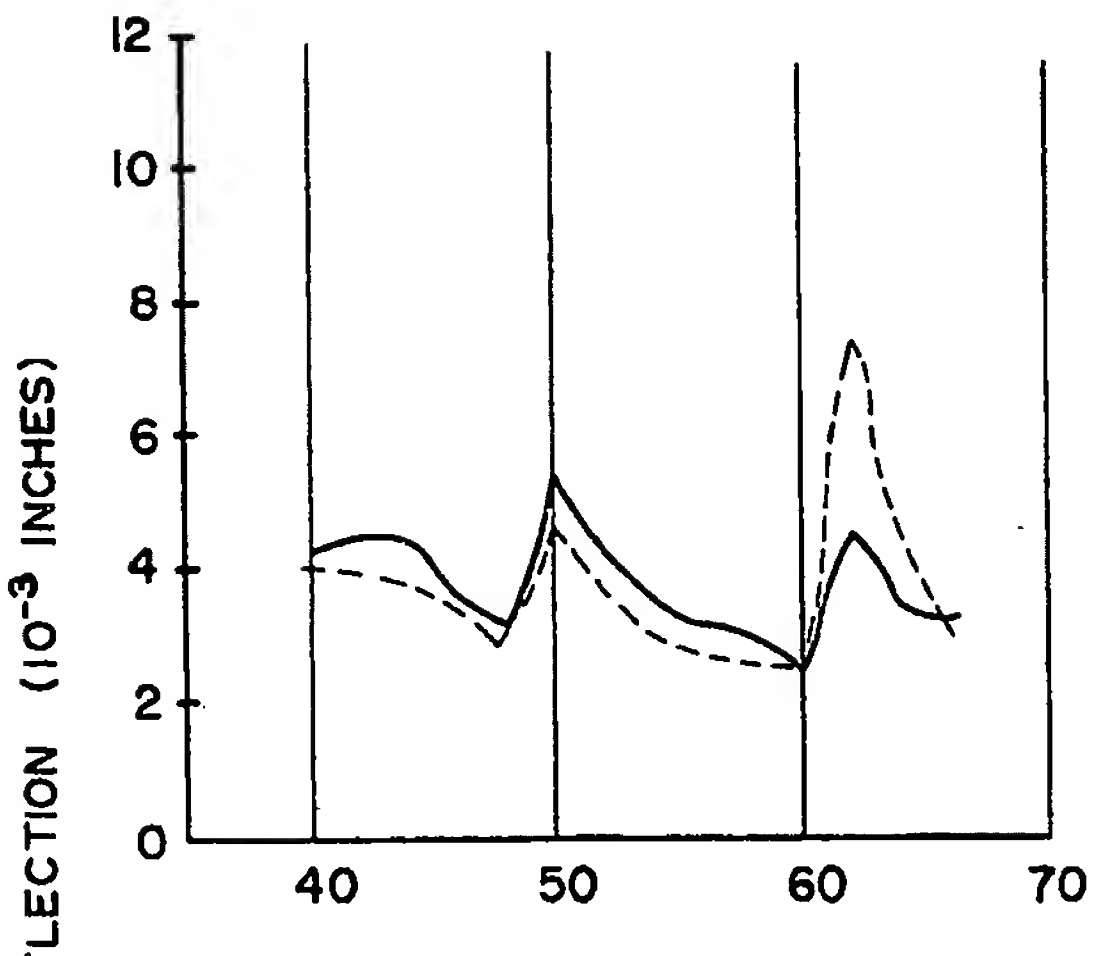


FIG - 8

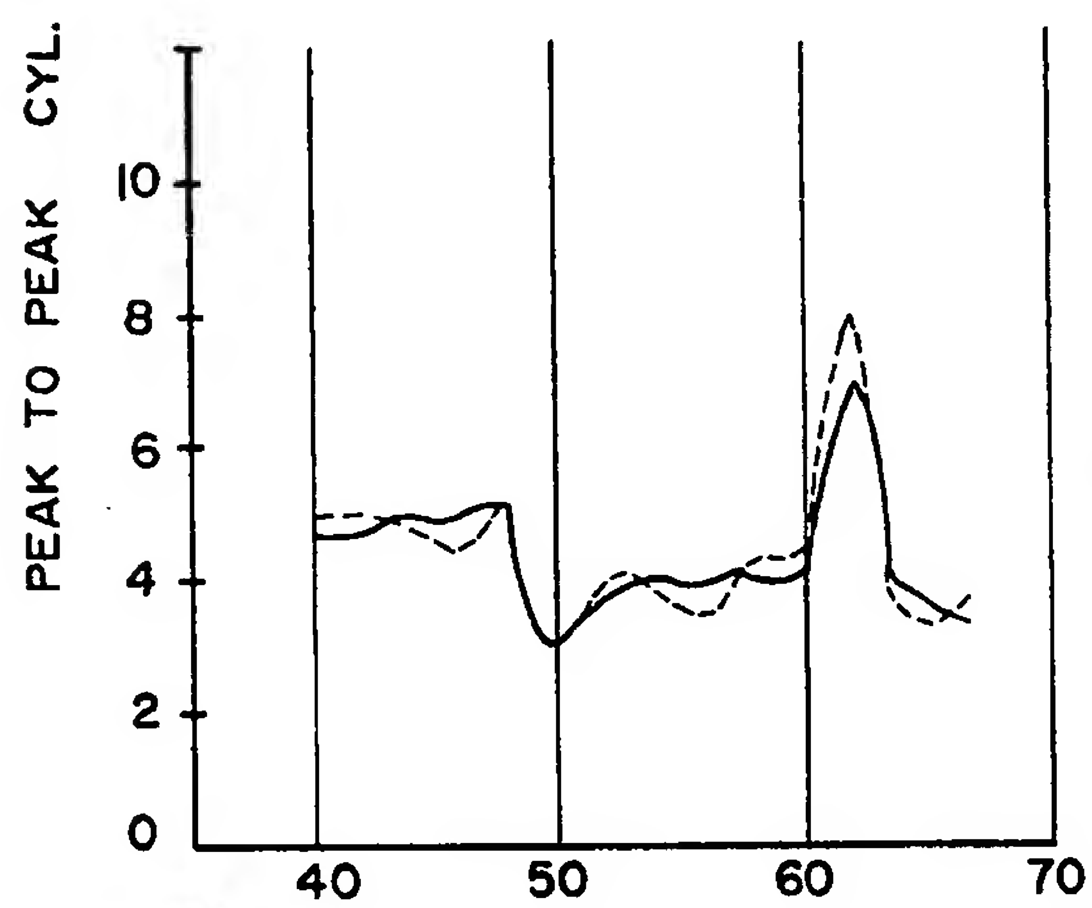


FIG - 9

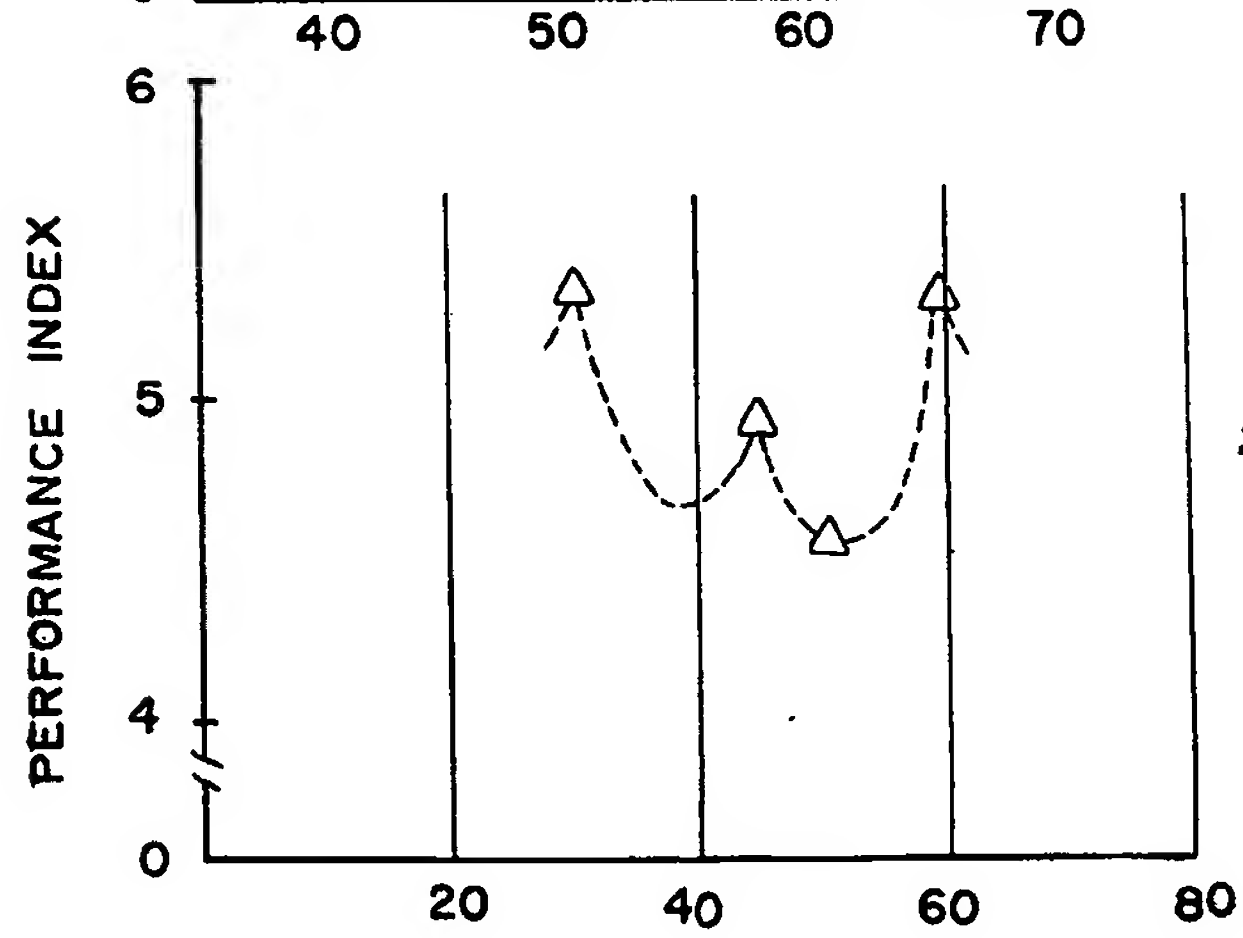


FIG - 10